

Questions and Answers About *Bacillus thuringiensis* (*Bt*)

What is *Bacillus thuringiensis* (*Bt*)? *Bacillus thuringiensis* is a type of bacteria which does not cause illness in humans. There are more than 30 strains, subspecies and serotypes of *Bt*, some of which may cause infection or produce toxins fatal to some insect species, including butterflies and moths. Various types of *Bt* produce specific toxins which affect different insect species. *Bt* is widely distributed in nature and is found in California where it naturally causes deaths in susceptible caterpillar populations every year. Products containing *Bt*, have been evaluated and approved by the U.S. Environmental Protection Agency (U.S. EPA) and the California Department of Pesticide Regulation (DPR) for use in pest management. The application of these products increases the concentration of *Bt* within an application area, and therefore improves *Bt*'s effectiveness against susceptible pest populations.

How well has *Bt* been tested? *Bt* has been administered to laboratory animals via oral, inhalation, dermal and injection routes without producing infection or toxicity. Human volunteers exposed to *Bt* via oral and inhalation routes have not become ill. Since *Bt* is naturally occurring, no acute toxicity has been demonstrated and specific testing for carcinogenicity, chronic toxicity, developmental and reproductive toxicity, as is done with chemical pesticides, are not deemed necessary. The U.S. EPA noted in the Federal Register, May 3, 1995, that: "...approximately 176 different *B. thuringiensis* products have been registered since 1961, and the Agency has not received any reports of dietary toxicity attributable to their use."

How does *Bt* work? *Bt* organisms produce specific substances, called endotoxins and exotoxins, which are responsible for the variance in pathogenic and toxic characteristics of different strains and varieties. When an insect eats the bacteria or its spores along with the toxins, its digestive processes are disrupted and they soon die. This action is specific to susceptible insects and does not occur in mammals, including humans.

What effect can *Bt* have on people? Other than individual reports of unusual circumstances in which persons have grossly contaminated an eye, or an open wound, no adverse human health impacts have been attributed to *Bt*. *Bt* has been used extensively in the U.S., Canada, and parts of Europe to combat gypsy moth and other lepidopteron insects, including use in densely populated areas. Health monitoring of exposed populations has not shown any discernable association between the application of *Bt* and infectious or allergic reactions in those populations, or the incidence of other illness or illness complications, including immune compromised individuals, elderly citizens, or individuals with chronic health problems. *Bt* has been found incidentally in some patients, however, the consensus of medical reviewers is that it was not possible to attribute the presence of *Bt* as a cause of any illness, or as a contributing factor.

What effects might *Bt* have on other animals or the environment? *Bt* survival in the environment is limited. Spores are susceptible to ultraviolet light and are rapidly inactivated. Spores reaching the soil compete poorly with other naturally occurring microorganisms. Survival time depends on environmental conditions e.g. pH, nutrients, moisture, aeration, etc. Survival times have been measured in weeks to, in some cases, a year or longer. *Bt* does not persist in aquatic environments, and fish populations are not known to be adversely affected. Some non-target moths and butterflies may suffer temporary population declines in large-scale *Bt* spray programs. During a gypsy moth eradication project in Oregon involving extensive aerial spraying with *Bt*, a depression in both diversity and total number of individual caterpillar species occurred in the treatment area for a period of three years. Variables such as climate, the number of generations per year, dispersal ability, alternate hosts and size of the spray area all modified the effect of *Bt* on individual species and the rate these non-target populations re-established themselves. No permanent adverse environmental impacts were observed.